INSTRUCTION MANUAL

MODEL 151B

CONSTANT CURRENT SUPPLY

• ELECTRONIC INSTRUMENTS

Quan-Tech

LABORATORIES INC.

WHIPPANY, N. J.

INSTRUCTION MANUAL

MODEL 151B

CONSTANT CURRENT SUPPLY

FOR SERIAL # 475

QUAN-TECH LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

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I GENERAL DESCRIPTION

The Quan-Tech Laboratories Model 151B is a solid-state Constant Current Supply designed to provide a constant D-C output current which is independent of the voltage drop across the load. The characteristics of this supply simulate a very high voltage in series with a high resistance.

The magnitude of the output current is variable over a wide range and the upper limit of the output terminal voltage can be preset to prevent damage to the circuit under test due to excessive voltage.

Terminals provided at the rear of the case permit A-C modulation of the D-C output current through the use of an isolated, external modulating source. Peak modulation current very nearly equal to 100% of the D-C output current is obtainable.

The output terminals are isolated from both case ground and A-C line connections.

II SPECIFICATIONS

Output Current	0.05 to 500 ma. D-C in four ranges; 0.05 to 0.5 ma., 0.5 to 5 ma., 5 to 50 ma., and 50 to 500 ma.
Output Terminal Voltage	Maximum output terminal voltage is adjustable from 2 to 20 volts.
Regulation	Less than 0.25% from 0 to 20 volts load. Less than 0.25% from 105 to 125 volts A-C line.
Ripple and Noise	0.05 - 0.5 ma range, less than 1.5 microamps. 0.5 - 5 ma. range, less than 1.5 microamperes. 5 - 50 ma. range, less than 15 microamperes. 50 - 500 ma. range, less than 50 microamps.
1 Kc Internal Impedance	0.05 - 0.5 ma. range, greater than 1 Megohm. 0.5 - 5 ma. range, greater than 1 Megohm. 5 - 50 ma. range, greater than 100K ohms. 50 - 500 ma. range, greater than 10K ohms. (For minimum impedance at frequencies higher than 1Kc refer to Minimum Internal Impedance vs: Frequency curves on page 8 .)
Over Voltage Protection	A voltage regulator circuit limits the output terminal voltage to any value between 2 and 20 volts. The desired value is preset by means of the OPEN CKT VOLTAGE control knob on the front panel.

II SPECIFICATIONS (Cont'd)

Power Input	105 to 125 volts, 50-60 cycles, 35 watts.
Dimensions	Height 8¼", Width 5", Depth 7 3/4" overall.
Weight	8½ pounds.

III OPERATING INSTRUCTIONS

Function of Controls and Panel Meter

SELECTOR SWITCH (S2) - Located in the upper right corner of the front panel. This switch changes the circuitry and meter shunt to make available the indicated current range or open circuit voltage reading as desired. A X0.1 multiplier must be applied to the meter reading on the 0.05 to 0.5 ma. range, a X10 multiplier on the 5-50 ma. range, and a X100 multiplier on the 50-500 ma. range. On the 0-25V position of the switch (engraved in red) the output terminals are internally short circuited and the meter becomes a 25 volt full scale voltmeter (voltmeter scale also in red) which indicates the open circuit voltage present at the output terminals when the SELECTOR SWITCH is turned to any of the four current ranges.

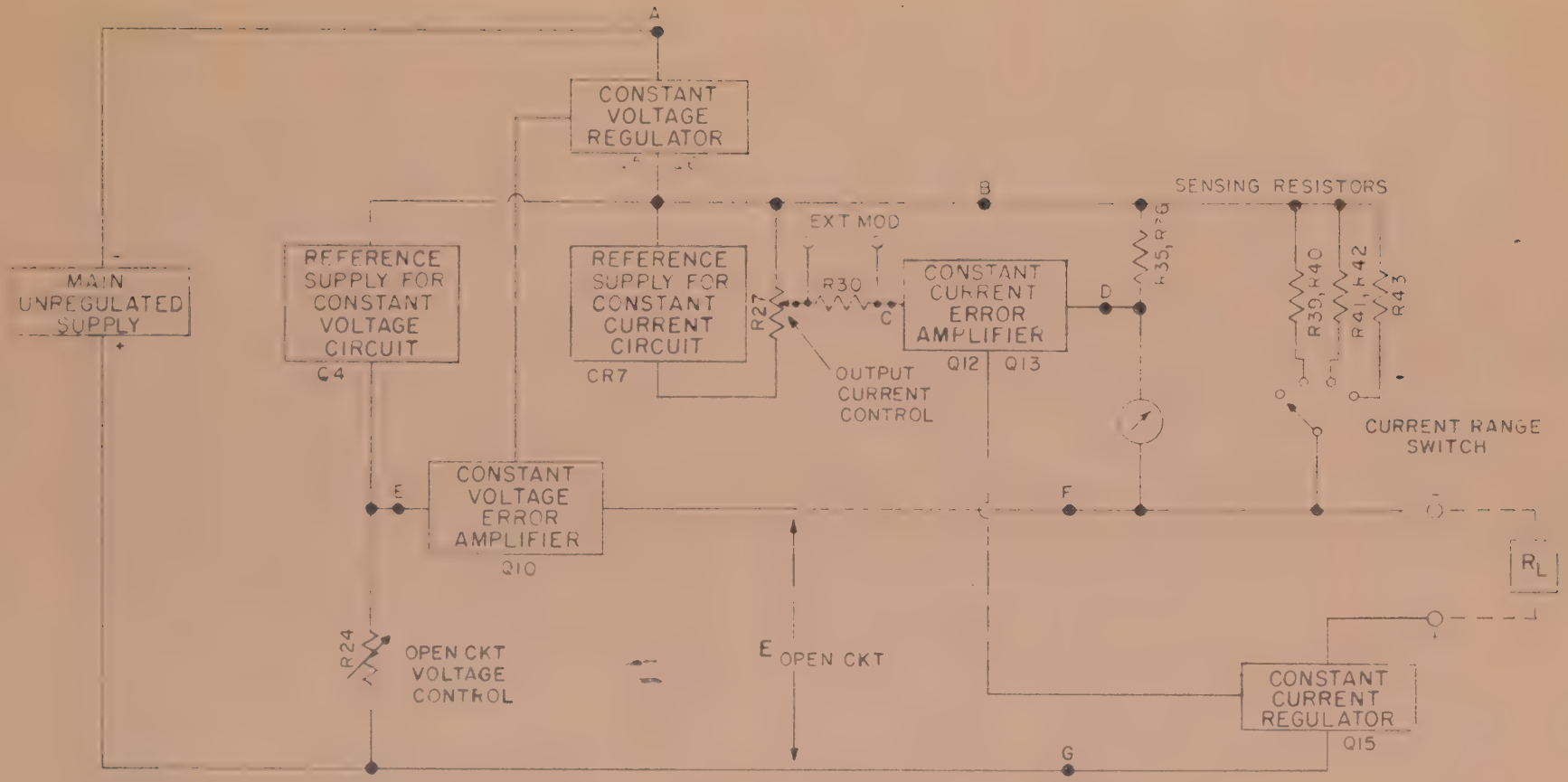
OPEN CKT VOLTAGE control (R24) - Located in the upper left corner of the front panel. The maximum terminal voltage under any load condition including open circuit is set with this control.

CURRENT CONTROL (R27) - Located directly below the panel meter. The output current level is set with this control to any level within the range indicated by the SELECTOR SWITCH.

First Time Operation

The Model 151B can be turned on with the controls in any position and with any passive load connected to the output terminals without causing damage to the instrument. If the possibility of causing damage to the circuit under test exists, the following procedure should be observed.

1. With the power supply switch at "off", plug power cord into 105 - 125 volt, 50 - 60 cycle supply.
2. Short circuit output terminals and turn power switch to "on".
3. Turn SELECTOR SWITCH to 0-25V position and set OPEN CKT VOLTAGE control for a voltage known to be safe for the circuit under test but at least 2 volts greater than the required load voltage.
4. Turn SELECTOR SWITCH to desired current range, and set CURRENT control for required current.
5. Remove short circuit from output terminals and connect circuit to be tested.



SIMPLIFIED BLOCK DIAGRAM
CONSTANT CURRENT SUPPLY
MODEL 151B

IV THEORY OF OPERATION

Simplified Block Diagram Description

The right half of the Block Diagram shown on the preceding page is the constant current portion of the circuitry contained in the Model 151B. The circuit outlined on the left half of the page is a variable constant voltage supply from which the constant current section operates.

A constant current output is obtained by passing the load current, or a portion of the load current, through sensing resistors R35, R36 and comparing the resulting voltage drop (VDB) to the fixed voltage (VCB) at the rotor of the reference potentiometer, R27 (CURRENT CONTROL). The difference between these two voltages (VCD) appears as an input to the CONSTANT CURRENT ERROR AMPLIFIER. When VCD is not zero the output of the CONSTANT CURRENT ERROR AMPLIFIER changes the bias condition of the CONSTANT CURRENT REGULATOR transistor so that the corrected load current through sensing resistors R35, R36 reduces VCD to zero.

The function of the constant voltage supply is to limit the maximum output terminal voltage to a preselected value (set with OPEN CKT VOLTAGE control) under any load conditions including open circuit. The method of regulating the constant voltage section differs from that of the constant current section only slightly. When the open circuit voltage (VGF) is not equal to the fixed voltage (VGE) across the reference rheostat R24 (OPEN CKT VOLTAGE control) the output of the CONSTANT VOLTAGE ERROR AMPLIFIER causes the CONSTANT VOLTAGE REGULATOR transistor to correct the error.

It can be seen from the block diagram that the open circuit voltage must always divide across the CONSTANT CURRENT REGULATOR and the load resistor, and that the division is determined by the value of the load resistance. Since the CONSTANT CURRENT REGULATOR requires a minimum of 2 volts in order to function, the OPEN CIRCUIT VOLTAGE MUST ALWAYS BE SET AT LEAST TWO VOLTS GREATER THAN THE REQUIRED LOAD VOLTAGE! In many applications the OPEN CKT VOLTAGE control can be turned fully clockwise (approx. 23.5V), thereby insuring adequate operating voltage for the CONSTANT CURRENT REGULATOR as long as the load voltage is kept under the specified 20V maximum.

The DC output of the Model 151B is modulated by applying an external AC modulation voltage across R30 which is in series with the fixed reference voltage at the rotor of the reference potentiometer. In order to maintain VCD equal to zero (requirement for regulation previously discussed) the load current must have an AC component which will cause a voltage drop in the sensing resistors equal to that introduced into the reference by the modulating source.

For a given magnitude of modulation voltage across R30 and a fixed position of the CURRENT CONTROL the <u>per cent</u> modulation will be approximately constant on all four current ranges. For a given magnitude of modulation voltage across R30 the <u>magnitude</u> of the AC component in the output will remain constant on any one current

IV THEORY OF OPERATION (Cont'd)

range. (i.e. The magnitude of the AC component in the output current is independent of the position of the CURRENT CONTROL,R27.)

Peak modulation current very nearly equal to 100% of the DC output current is available. Approximately 0.5V RMS modulation voltage across R30 will correspond to 100% current modulation in the output at the low current end of any range; at the high end of any current range the modulation voltage required for 100% current modulation is approximately 5V RMS.

NOTE:

1. The modulation source connected across R30 should be isolated from line ground if another line ground is used in any of the external test equipment.

2. The modulation source should not have a DC component. If there is a possibility of DC being introduced through the modulation source a blocking capacitor should be used.

V MAINTENANCE AND REPAIR

General

The instrument may be removed from the case by removing four screws in the back panel. Do not remove screws from the front panel unless the case has been removed first, and then only to expedite repairs.

If soldering on the printed circuit board is necessary the iron should be just hot enough to melt the solder quickly and applied for as short a time as possible. Pressure that might push the copper away from the board while hot should be avoided.

The majority of the components in this instrument are standard commercial parts available at most suppliers. Special replacement parts such as the transformer, meter, etc. can be obtained from Quan-Tech Laboratories.

Adjustment Procedure

A. Maximum Open Circuit Voltage Adjustment

1. Connect a 100 ma. full scale ammeter directly across the output terminals with the Model 151B SELECTOR SWITCH in the 5 - 50 ma. position.

2. Set CURRENT CONTROL for approximately 10 ma. reading on the external meter.

3. Replace the ammeter on the output terminals with a 25VDC full scale voltmeter and turn the OPEN CKT VOLTAGE control fully clockwise.

4. Adjust R19 for 23.5V on external meter.

V MAINTENANCE AND REPAIR (Cont'd)

Adjustment Procedure (Cont'd)

B. Voltmeter Calibration

1. With setup the same as in A4 above, set OPEN CKT VOLTAGE control for 20V reading on external voltmeter.
2. Turn SELECTOR SWITCH to 0-25V position and adjust R37 for 20V reading on panel meter.

C. Ammeter Calibration

1. OPEN CKT VOLTAGE control set fully CW.
2. Connect 0-1 amp DC ammeter directly across output terminals with SELECTOR SWITCH on 50-500 ma. range.
3. Set CURRENT CONTROL for 500 ma. reading on external meter and adjust R35 for 500 ma. reading on panel meter.
4. Turn SELECTOR SWITCH to 5-50 ma. range and external ammeter to 100 ma. range.
5. Set CURRENT CONTROL for 50 ma. reading on panel meter and adjust R41 for 50 ma. reading on external ammeter.
6. Turn SELECTOR SWITCH to 0.5 - 5 ma. range and external ammeter to 10 ma. range.
7. Set CURRENT CONTROL for 5 ma. reading on panel meter and adjust R39 for 5 ma. reading on external ammeter.

Trouble Shooting

The following conditions were set up when the voltage readings on the Schematic Diagram were recorded:

AC line voltage - 115 VAC
SELECTOR SWITCH - 0-25V position
OPEN CKT VOLTAGE - full CCW)
CURRENT CONTROL - full CCW) upper reading

OPEN CKT VOLTAGE - full CW)
CURRENT CONTROL - full CW) lower reading

All readings taken with 20,000 Ω/v voltmeter
All readings taken with respect to buss indicated near upper left corner of schematic:
All readings in volts.

All transistors except Q11 are normally conducting when the Model 151B is set up as described above. In the conducting state the forward conduction voltage of the emitter-base junction is approximately 0.05 - 0.3 VDC. (Positive polarity at base with respect to emitter for NPN type and negative at base with respect to emitter for PNP type.) Any DC voltage present from emitter to base which is significantly different in magnitude or reverse polarity from that stated above is a symptom of improper operation.

V MAINTENANCE AND REPAIR (Cont'd)

Component Functions

Variable Constant Voltage Supply

35V winding of T1 - main output current supply.
CR3-6 - main supply silicon rectifier bridge.
C4 - main supply filter capacitor.
Q5,Q6 - constant voltage supply power regulator transistors.
Q3 - driver transistor for Q5,Q6.
Q10 - constant voltage supply error amplifier.
R8,Q4 - constant current source to supply constant voltage reference rheostat R24 (OPEN CKT VOLTAGE control)
R24 - reference rheostat for constant voltage supply (OPEN CKT VOLTAGE control)

Constant Current Section Reference Supply

12V winding of T1 - AC source for reference.
CR2 - half wave silicon rectifier for reference supply.
Q8,Q9 - two stage transistor regulator to provide constant current through zener diode reference.
CR7 - temperature compensated, silicon, zener diode reference
R27 - reference potentiometer (CURRENT CONTROL)
Q11 - transistor switch to dump reference voltage through R29, R30 on open circuit so that the CONSTANT CURRENT ERROR AMPLIFIER is not drastically overloaded.

CONSTANT CURRENT ERROR AMPLIFIER

Q12, Q13 - differential error amplifier for constant current section.

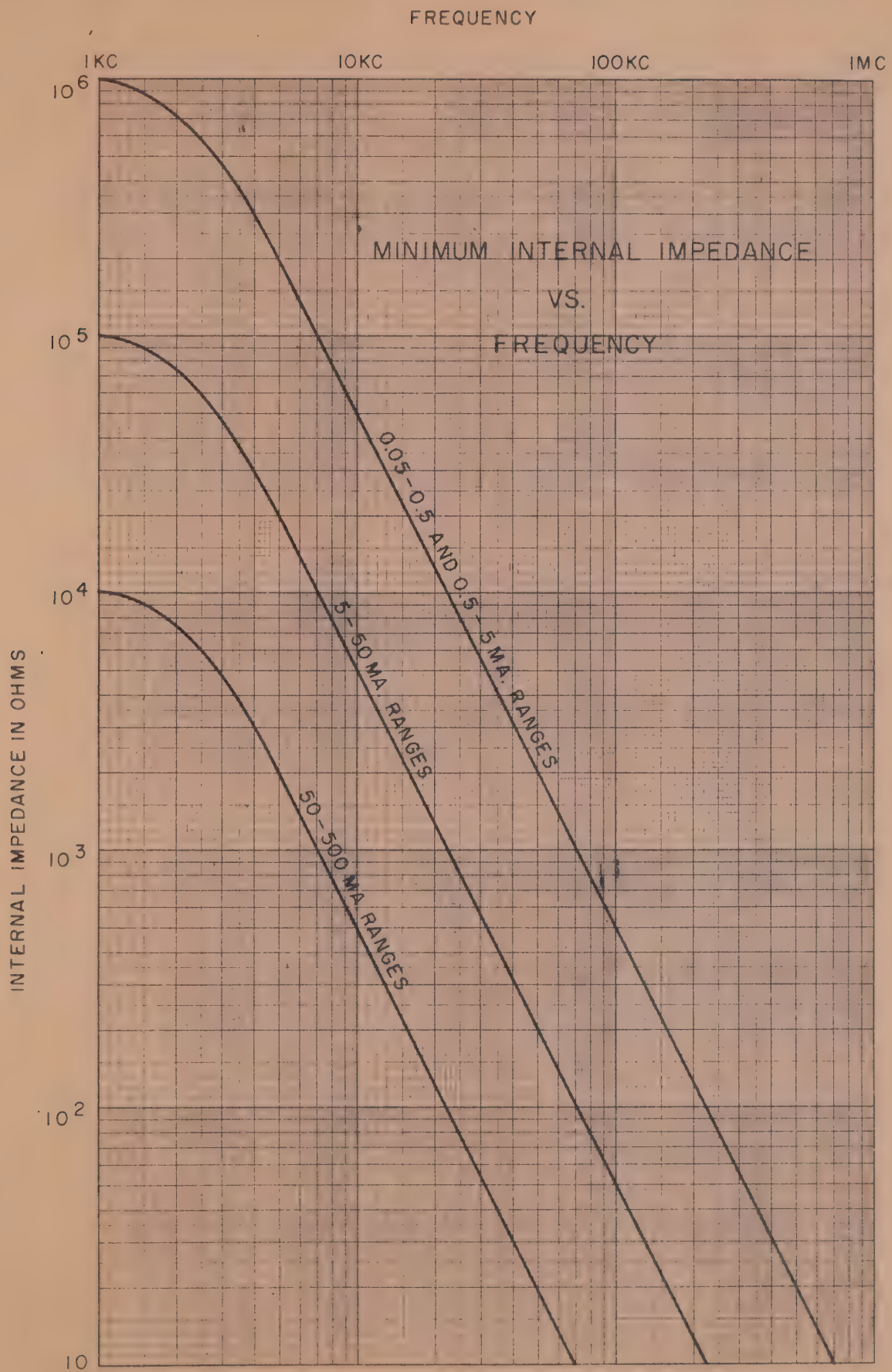
SENSING RESISTORS

R35,R36 - sensing resistors on 0.05-0.5 ma. range.
R39,R40 - sensing resistors shunt for 0.5-5 ma. range.
R41,R42 - sensing resistor shunt for 5-50 ma. range.
R43 - sensing resistors shunt for 50-500 ma. range.

CONSTANT CURRENT REGULATOR

Q14 - driver for constant current power regulator transistor.
Q15 - constant current section power regulator transistor.

MODEL 1518


FREQUENCY
1KC
10KC
100KC
1MC
10^6
10^5
10^4
10^3
10^2
10
INTERNAL IMPEDANCE IN OHMS
MINIMUM INTERNAL IMPEDANCE
VS.
FREQUENCY
0.05-0.5 AND 0.5-5 MA. RANGES
5-50 MA. RANGES
50-500 MA. RANGES

SEMICONDUCTOR LEGEND

Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

* It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

(OVER)

SEMICONDUCTOR LEGEND

Type # on schematic	Type # in equipment
2N414	2N396A, 4JX1G759, 4JX1D653
2N396A	4JX1G759, 4JX1D653
T1480	2N1613
T1494	2N1613
2N2603	2N3250
2N929	220N2

F2 3/4 A

CR1 IN2859 IN537

-16.2 -16.3

R44 560

R6 560

Q1 2N270

-8.44 -8.44

R5 12K

R8 1K

R4 390K TYP *

C2 .01

R1 8200

R2 6800

Q6 2N420 2N1541

Q3 2N270

Q5 2N420 2N1541

R11 8200

R12 6800

R14 1200

Q7 T1480

R13 1K

121

DS1 53

C1 500 25V

Q2 2N270

R3 6800

R7 1500

Q4 2N1304

R9 4.7

R10 4.7

MAX. OPEN CKT VOLT. ADJ.

500 MA. ADJ.

5 MA. ADJ

50 MA. ADJ

VOLTAGE REFERENCE BUSS

R16 8200

CR7 IN2163

R19 1K

R35 5K

R39 1K

R41 100

+9.32 +9.25

R26 120

C7 .01

Q11 2N414

+0.43 +8.87

R36 12K

R40 1200

R42 100

R43 15

C3 500 25V.

Q8 2N1304

CURRENT CONTROL R27 2.5K

+0.43 +8.90

R29 1200

R30 180

+0.47 +8.93

R17 1K

R20 82

+10.3 +10.3

Q12 T1494 2N169A

Q13 T1494 2N169A

CR13 IN816 IN482A

M1 MA

R15 27K

Q9 2N1304

R28 120

C10 .01 400V

C11 40 3V.

0-25 V.

.05-.5

.5-5

5-50

50-500

R18 4100

+16.5 +16.5

R34 220

S2A (S)

S2B (NS)

E1

CR2 IN2859 IN537

EXT MOD

C6 100 50V.

Q10 2N270

C8 .01 400V

CR12 IN816 IN482A

20V MAX

R31 470

S2C (S)

S2D (S)

E2

CR3 IN2859 IN537

-44.5 -14.7

R21 1K 2W

R22 470 2W

-6.03 +24.1

VOLTMETER CAL

R37 5K

Q14 2N414

CR11 IN2859 IN537

R23 470

+0.57 +9.3

R25 220

S1B

R38 47K

+2.17 +32.2

C9 2 200V

R46 15 TYP

T1

R24 2500

OPEN CKT VOLTAGE

Q15 2N420 2N1540 2N1541

C4 1000 50V.

C5 100 25V

+2.45 +32.4

R32 6800

R33 180

F1 1/2 A

R45 150 2W.

CR5 IN2859 IN537

CR8 IN2859 IN537

CR9 IN2859 IN537

CR10 IN2859 IN537

ON

CR6 IN2859 IN537

+4.65 +34.7

S1A

W1

F1

117 V A.C. 50-60 N

LEGEND

K = 1000

* = FACTORY SELECT

⊘ = SCREW DRIVER ADJUST

○ = FRONT PANEL CONTROL

▭ = FRONT PANEL CONTROL

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES IN OHMS
ALL RESISTORS 1/2 WATT
ALL CAPACITANCES IN MICROFARADS

SCHEMATIC
CONSTANT CURRENT SUPPLY
MODEL 151B

C-1885-J

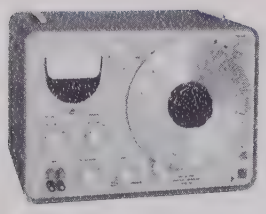
Short Form Catalog

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

Quan-Tech® GENERAL INSTRUMENTS

• ELECTRONIC INSTRUMENTS • ANALYZERS • AMPLIFIERS • SPECIAL INSTRUMENTS •

WAVE ANALYZERS



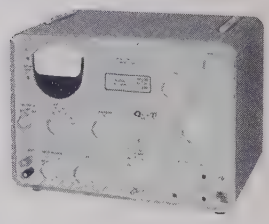
MODEL 303
WAVE AND NOISE SPECTRUM ANALYZER

Frequency range: 30 cps to 100 Kc. **Bandpasses:** 10, 30, 100, 1000 cps, selectable at front panel. (100 and 1000 cps bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 μv to 300 v, FS. Down to 1 μv FS with accessory Model 203 preamplifier (see below). ±300 cps vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1475

MODEL 2156 WAVE AND SPECTRUM ANALYZER

Similar to above except: **Frequency range:** 10 cps to 30 Kc. **Bandpasses:** 3, 10, 30, 300 cps. Price: Upon request.

MODEL 304
LOW FREQUENCY WAVE & SPECTRUM ANALYZER



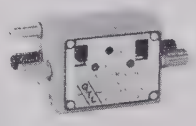
Frequency range: 1 cps to 5 Kc; **Bandpasses:** 1, 10 & 100 cps, selectable at front panel; **Skirt Selectivity:** 24 DB per 1/2 bandwidth; **Voltage range:** 30 μV to 100 v, FS; down to 3 μV FS with accessory Model 201B preamplifier (see below); **Tuning:** Manual or automatic; Internally supplied electronic sweep of total frequency range or of any portion; provision for external sweep; **Frequency Calibration:** Linear; **Outputs:** BFO, sample of automatic sweep, analogs of meter readings and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2350

OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. Prices: Upon request.

SOLID STATE AMPLIFIERS

MODEL 201B
DC DECADE AMPLIFIER
AC OR DC COUPLED

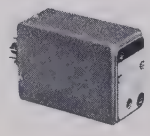


Bandwidth: DC or 10 cps to 3Mc (3db); **Gain:** 10 (fixed); Power: Self-contained batteries; 600 hour life. **Price:** $110

MODEL 203
LOW NOISE AC AMPLIFIER

Bandwidth: 30 cps to 100 Kc (±0.5 db); —3 db at 500 Kc; **Gain:** 100 (fixed); **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. Battery powered; **Price:** $125

MODEL 205
HIGH-STABILITY DC AMPLIFIER



Bandwidth: dc to 100 Kc (0.5 db down); 3 db down at approx. 500 Kc; **Gain:** 10 (fixed); **Typical drift:** less than 250 μv at constant ambient, input shorted. External + & — 12 v required. **Price:** $105

MODEL 206
SELECTABLE GAIN AC AMPLIFIER

Bandwidth: 10 cps to 100 kc (within 0.5db); —3db at 500 Kc. **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. **Gain:** 10, 100 & 1000, selectable at front panel; **Power:** 105-125 v AC or optional self-contained battery pack (automatically recharging). **Price:** $165, Batteries $25.

MODEL 301-B
E-I METER
SENSITIVE AC VOLTMETER-MICROAMMETER

AC voltage range: .001 to 300V, FS. **AC current range:** .001 to 30 ma, FS. **Accuracy:** 2% voltage, 3% current, 20 cps to 0.5 Mc. Separate isolated current terminals. **Input impedance:** Voltmeter, 3 meg + 50 pf. Microammeter < 2.5 ohms + 10 μh. Completely transistorized. Price $305.

MODEL 1104 CLAMP-ON PROBE

0.1 ma to 3 amps FS. ± 5% 50 cps to 50 Kc Price $65.

SPECIAL INSTRUMENTS

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

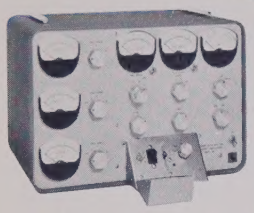
All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

Quan-Tech LABORATORIES, INC.

43 SO. JEFFERSON ROAD, WHIPPANY, NEW JERSEY - 07981 • PHONE (201) 887-5508

Quan-Tech®

NOISE INSTRUMENTS



MODEL 310 TRANSISTOR NOISE ANALYZER

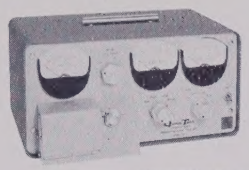
Measures noise current and voltage at 100 cps, 1 Kc and 10 Kc, as well as I_{cbo}, I_{ebo} and beta. **Noise voltage range:** 0.01 to 3 μv/root cycle, FS. **Noise current range:** 1 to 300 pa/root cycle, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 v. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2375

MODEL 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 μa for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2575

MODEL 312 TRANSISTOR NOISE ANALYZER

Similar to Model 310, but designed for measurement of field-effect transistors. **Drain voltage range:** 0.1 to 30 v. **Drain current range:** 0.05 to 30 ma. **Gate Bias range:** 1 v forward to 15 v reverse, continuously adjustable. Also measures transconductance. **Price:** $2575.



MODEL 510 TRANSISTOR NOISE ANALYZER

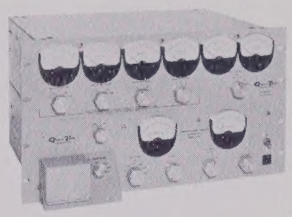
Similar to Model 310 except that it measures noise current and voltage at 1 Kc only. No beta or leakage measurements. **Noise voltage range:** 0.01 to 3 μV/root cycle FS. **Noise current range:** 1 to 300 pa/root cycle FS. **Collector voltage range:** 3 to 30v. **Collector current range:** 0.1 to 10 ma. **Base resistance range:** 0, 500, 1K, 10K ohms plus external position. Also measures FET's. **Price:** $1095.

MODEL 511 TRANSISTOR NOISE ANALYZER

Identical with Model 510 except **Collector current range:** 3 to 300 μa. **Price:** $1145.

MODEL 512 TRANSISTOR NOISE ANALYZER

Similar to Model 510 except that it measures broadband (10 cps to 15.7 Kc) noise figure. **Collector current range:** 10 μa to 1 ma. **Price:** $1145.



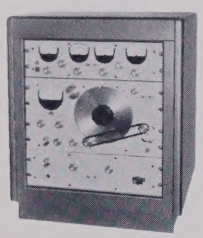
MODEL 2173-2181 TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 cps, 1, 10, and 100 Kc simultaneously. **Noise voltage range:** 3 to 3000 nanovolts/root cycle FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 μa to 30 ma. Also measures FET's. **Price:** $4950.

VERY LOW FREQUENCY NOISE ANALYZER

On special order we can supply a test jig and preamplifier for use with the Model 304 Low Frequency Wave and Spectrum Analyzer for making noise measurements at frequencies down to 1 cps. Write us outlining your requirements.

MODEL 2158 NOISE ANALYSIS SYSTEM



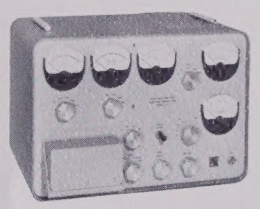
Measures noise in any component or system from 30 cps to 100 Kc. Consists of Model 303 Wave Analyzer with motor driven sweep, two preamplifiers, and two metered power supplies. **Preamplifier gain:** 10, 100, 1K, and 10K. **Input impedance:** 100K + 50 pf or 10 meg + 50 pf. **Typical input noise:** 4 x 10^{-9} V and 2 x 10^{-12} A (100K input), 8 x 10^{-9} V and 6 x 10^{-14} A (10 meg input), per root cycle at 1 Kc. **Power Supplies:** 0.1 to 30 volts and 1 to 450 volts at 100 ma. each. Overload protected. **Ripple:** 1 microvolt max. **Price:** $5200.

MODEL 315 RESISTOR NOISE TEST SET

Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100Ω to 22 meg Ω. **Measurement range:** 0.6 μv in a decade to 1000 μv in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $1950

MODEL 2136

Similar to above, but measures resistors down to 10 Ω. **Price:** $2300



MODEL 327 DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 cps and 1 Kc simultaneously. **Noise voltage range:** 0.03 μv to 1 mv/cycle of bandwidth. **Test voltage:** 0 to 500v, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750

TEST JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

MODEL 317 AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude - probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 cps and 1 Mc; **Switching rate:** 5 Mc; **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450

MODEL 420 RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** dc to 100 Kc; **Output voltage:** 0.01 to 1000 μv/root cycle, continuously variable, calibrated; **DC offset:** less than 10 mv at max. output. **Price:** $525

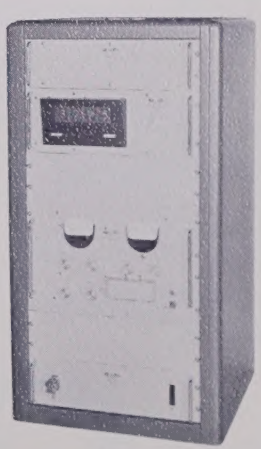
MODEL 2184 DIGITAL RESISTOR NOISE TEST SYSTEM

Digitizes, stores, and presents resistor noise data. Consists of Model 2136 Resistor-Noise Test Set plus three digital voltmeters, storage, timing circuits, and optical and punch-card readout. Automatic sequence converts, sums, and stores five total noise readings, five system noise readings, and applied DC voltage. Presents three data channels simultaneously to punch-card system, plus selectable optical readout of any channel. All digital circuitry designed and built by Quan-Tech. **Price:** $9500.

MODEL 2170-71-72 AUTOMATIC RESISTOR NOISE TEST SYSTEM

High-speed automatic sorting of resistors by Noise Index. Sorts 3000/hr. at ± 1 db tolerance, 6000/hr. at ± 3 db tolerance. Higher speeds obtainable by adding additional channels. **Price:** $12,900. (less mechanical handling)

The above systems and modifications of them can be adapted to measuring noise in transistors and diodes. Write us outlining your requirements.



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A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

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